2 Hardware And Software

2.1 Mainframe computers and supercomputers

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Mainframe Computers

- Mainframe computers are large powerful computers that have high processing power than normal computers and can serve several terminals
- Mainframes use parallel processing
- They are multitasking, multi user computer that allow multiple people to work on different problems at the same time
- It can have hundreds of processors core which all share on operating system

Supercomputers

- They are large computers which use massively parallel processing that allows them to complete highly complex tasks quickly
- The can have more than 100 000 processing core, where each core has their own operating system.
- Supercomputers use more than one GPU
- A supercomputer only runs very few computer programs and its focus is on executing instructions as quickly as possible for one purpose in order to be used at their maximum capacity

Characteristics of Mainframe and Supercomputer

Longevity

- Mainframe computers have great longevity or life spans; they can run continuously for very long periods of time with minimum downtime. Shutting them down and then disposing off their hardware is very expensive

- They are made to last for decade and still work well
- Supercomputers have a lifespan of about 5 years, they tend to be used by organization such as meteorology until a much faster supercomputer is introduced to market

RAS

- Used when referring to mainframe computers and stands for reliability, availability and serviceability *(this characteristic is not used for supercomputers)*
- **Reliability:** most reliable computers since their processors are able to check themselves or errors and are able to recover without any undue effects on the mainframes operation. The system software is also very reliable as it is thoroughly tested and updates are made quickly to overcome any errors
- **Availability:** refers to mainframes being available all time and extended periods, Mean time between failures (MTBF) is a measure of system, it is the average time that exists between downtime during a systems normal operation. Mainframes give months, or years of system availability between downtimes. The period of downtime is also short as mainframes are able to recover quickly. This is because mainframes usually come with spare components like extra CPU that are automatically used when a failure occurs, the operator is alerted and CPU or component is replaced at a later time but throughout the system continues to work normally.
- **Serviceability:** this is the ability of a mainframe to discover why a failure occurred and means that hardware and software components can be replace without having too great an effect on the mainframes operation

Security

- Mainframe have greater security than other types of computer system that enables it to share a company's data among several users but still be in a position to protect it. A mainframe has many layers of security including:
    - User identification and authentication including multi factor authentication such as password, physical token, biometric identifier or time restricted PIN
    - Levels of access, which means that users can only see sets of data depending on the their level of security
    - Encryption of transmitter data and data within the system
    - Secure operating systems

    - Continual monitoring by the system for unauthorized access attempts
- Supercomputers use end to end encryption which means that only sender or recipient is able to decrypt and understand the data. This is vital when used for storing sensitive data like DNA profiles

Performance Metrics

- Performance metrics are the measures used to determine how well or fast the processor deals with data
- The speed of a mainframes CPU is measured in millions of instructions per second (MIPS)
- not the best measure as not all instruction used by mainframe are same with some being simple and straightforward that take less time and other being more complex and slower to process
- MIPS are often linked to cost by calculating how much a mainframe costs per one million instruction per second
- supercomputers make use of FLOPS which is how many floating point operations can be carried out per second as they are used mainly with scientific calculations
- modern supercomputers performance is measured in petaflops/quadrillion of flops
- flops can be an unreliable measure as they don't take into account CPU's clock speed, bus speed and the amount of RAM available

Volume of Input, Output and Throughput

- Mainframes have specialized hardware, called peripheral processors that deal with all input, output operations leaving CPU to concentrate on the processing of data
- This enables mainframes to deal with large amounts of data being input, records being accessed and large volumes of outputs being generated. Modern mainframs can carry out billions of transactions every day
- The large number of simultaneous transactions and large volumes of input and output in a given period is referred to as throughput
- A supercomputer is designed for maximum processing power and speed, whereas throughput is a distinct mainframe characteristic

Fault Tolerance

- A computer with fault tolerance means it can continue to operate even when one or more of its components has failed, it may operate at a reduced level but not fail completely
- Mainframe computers have the characteristics of being fault tolerant in terms of their hardware.
- If a processor fails to function the system automatically switches to another processor without disrupting the processing of data. The same can be done with a software error/failure by having two different versions of a software where in case of an error, the other version is automatically run
- Supercomputers have ore components than a mainframe with a lot more processors which means failure is more likely to occur and consequently interrupt the operation of the system
- The approaches to fault tolerance is same as mainframe but with millions of components the system can go down at any time even though it tends to be up and running again quite quickly

Operating System

- Most mainframes run more than one operating system at any given time
- The OS on a mainframe divides a task into various sub tasks, assigning each one to a different processor core
- When each sub task has been processed the results are recombined to provide a meaningful output, this is called parallel processing
- Supercomputers tend to use only one OS but most supercomputers utilize massively parallel processing in that they have man processor cores, each one with its own OS

Type of processor

- Early mainframes had just one processor (CPU) but modern mainframes have multiple processors called CPU complexes
- The number of processor cores found in mainframe is now measured in hundreds.
- Supercomputers have hundreds of thousands of processor cores
- Modern supercomputers use more than one GPU or graphics processing unit unlike mainframes

Heat Maintenance

- Because of large number of processors in both mainframes and supercomputers, overheating becomes a major problem and heat maintenance has to be implemented
- In older mainframes heat produced wasn't controllable using cooling by fans hence liquid cooling systems had to be used. Later mainframes manufactured in 1980s produced less heat and hence fans were used.
- Recent mainframes however involve more powerful hardware hence overheating becomes an issue, air cooling systems become more complex and expensive for heat maintenance hence water cooling solutions have resurfaced again as they are more cost effective
- Supercomputers always had overheating issues, the large amount of heat produced also directly affects the lifetime of components along with the processors
- Supercomputer draw enough megawatts of power to keep them running at high efficiency that its enough to power several thousand home
- This along with having so many processors close together creates excessive heat and requires the use of direct liquid cooling to remove any excess heat

Mainframe Computer Uses

Census:

- It is an official population survey of the people and households in a country that is carried out in order to find out how many people live
- It's used to obtain details of such things as peoples ages and types of employment, this amount of data that has to be processed is enormous
- A census takes place every ten year and as the population increase each census produces more so the use of mainframes to process data becomes crucial

Transaction Processing:

- Transaction processing consists of more than one computer processing operations which combine to make a single transaction.
- Each of these operations must be carried out without error otherwise the transaction will be deemed to have failed and the transaction processing system will remove all traces of the operations and the system will continue as thought the transaction never happened

- However if the transaction is successful, the relevant database is updated before the system continues onto the next transaction
- The effectiveness of a transaction processing system is often measured by the number of transactions it can process in a given period of time and hence uses MIPS.
- The system must be continually available during the times when users are entering transactions and it must be able to deal with hardware and software problems without affecting the integrity of the data
- It must also be possible to add, replace or update hardware and software components without shutting down the system
- With its ability to transfer processing from one core to another the mainframe is more than suitable for this task

Industry Statistics:

- These are statistics that are recorded regarding trends in different industries such as those that process raw material, make goods in factories or provide services
- Business in certain sectors of industry need mainframes to process the vast amount of data which helps identify their major competitors
- It shows their competitors share of market and the trends in sales and helps identify those products which could compete profitably with other businesses
- Companies could also obtain reports from organizations that collect the data for them and those companies could use mainframes for this purpose

Consumer Statistics:

- Consumer statistics allow businesses to assess the demand for their product.
- They can inform them about the range of household incomes and employment status of those consumers who might be interested in the product so that a price can be set
- This data can also inform businesses of major consumer geographical locations for local sales or how inclined they are to use the internet for shopping
- It also allows businesses to know how any similar products are available to consumers and what price they pay for them
- These statistics produce an incredible amount of data and the organizations that produce these statistics use mainframes

Supercomputer Uses

Quantum Mechanics:

- it is the study of the behavior of matter and light on the atomic and subatomic scale
- it attempts to describe the properties of the constituent parts of an atom, such as electrons, protons and neutrons and how they interact with each other
- these require very large number of calculations that need great accuracy and thus require the use of a super computer

Weather Forecasting:

- it is based on the use of very complex computer models, data from the sensors at weather station around the world is input into the model and then many calculations are performed
- they also store records of previous weather conditions over very long periods
- using the past weather readings, the computer examines similar patterns of weather to those being experienced at the moment and is able to predict the resulting weather
- variables such as atmospheric pressure, humidity, rainfall , wind and wind direction are recorded using computerized weather stations around the world
- these readings together with observations from radar satellites, surroundings from space and information from ships and aircraft help supercomputer to produce 3-D model of the earth's atmosphere
- because of the complexity of the calculations and the very large number of them that need to be carried out, they can only effectively run on super computers

Climate Research:

- it is an extension of the use of IT in weather monitoring
- climate is measured over a longer time scale and data is collected over several decades to show the trends of different variables over time such levels of nitrogen dioxide, ozone, sulphur dioxide in air, etc
- Also the interaction of various earth components such as animals, humans, volcanoes, weather, heat from sun are used in climate research and described in mathematical terms

- These are considered variable which have to be collected and complex calculations performed onto them hence we rely on computer models to understand how this system works
- Climate is one component of this planets system and only supercomputers are able to run the models that represent the interactions between the components of this system
- Supercomputers used for climate research include models which allow for atmosphere, land, ocean, ice and uses various equations to mimic the process of climate change using virtual environment created on a supercomputer
- They are also being used as climate change is becoming a potentially catastrophic situation.

Advantages of Mainframes

- They are very reliable and rarely have any system downtime. This is why organizations such as bank use them for 24/7 operations throughout the week
- Hardware and software upgrades can occur while the mainframe system is still up and running
- Mainframe are getting faster and more powerful every year, outperforming PCs, laptops and other devices
- Mainframes can deal with huge amounts of data that organization need to store and process. Mainframes ability to run on different operating system, can allow it to cope with data coming in a variety of database formats which other platforms would find problematic.
- Mainframes have stronger security than other system which have complex encryption systems and authorization procedures in place

Disadvantages of Mainframes

- Mainframes are very expensive and can only be afford by large organizations such as multinational banks
- There is also high cost for the personnel required to run and maintain them
- They require large rooms to house the system which isn’t needed with other system

- Recent mainframes are becoming super advanced and hence more heat maintenance is required which can be expensive as cooling system needed to install and run for them are complex and costly
- The software required to run mainframe system is more expensive to buy than using cloud hence more organizations are shifting to cloud services as they don't also need to hire expertise for them

Advantages of Supercomputers

- They are the fastest data processing computer
- Supercomputers use massively parallel processing, which makes them more powerful compared to the parallel processing of mainframes and PCS which have far fewer processors core than mainframes or supercomputers

Disadvantages of Supercomputers

- They are the most expensive to buy and install
- Most supercomputers only have operating system where mainframes can have more than one
- Supercomputers are less fault tolerant than mainframes meaning they are likely to recover as quickly in the event of a failure of a component
- They are down more often than mainframes but not as often as other systems

2.2 System software

System software refers to the programs that run and control a computer's hardware and application software; the following are examples of it

Compilers

- A compiler is a computer program that translates program written in a high level programming language called source code into an executable file called object code.

- it translates the whole program in one complete unit
- It produces an executable file of code which can be run directly without the need for compiler to be present
- It also produces a list of error messages after it has translated the program which can help debug the program
- These errors can't be corrected without going back to the source code hence the program needs to be recompiled after it has been debugged

Advantages:

- A compiled program doesn't have to be translated again and again
- A compiled program can urn much faster than an interpreted software
- Compiling a program is much quicker process than interpreting as whole program is translated in one go unlike interpreter which translate one line at a time
- With compiled program, the source code has been translate and machine code is difficult to understand alter so it improves security
- It produces an executable file of code
- It doesn't require the compiler to be present at run time

Disadvantages:

- While a program is being compiled, the programmer has to wait doing nothing before they can correct errors. This could take along while if it's a major application
- A compiler outputs a list of error at the end of compilation, which could make locating the errors and finding their cause tricky. The whole program needs to be compiled again after an error is corrected
- A compiled program can only run on a computer with same operating system as the computer it was originally compiled on
- Compiling program makes use of more memory than interpreting as the whole program must be loaded before translation whereas in an interpreter only a few statements of the program have to be in memory at any given time.
- Unlike an interpreter it doesn't allow small pieces of code to be tested to make sure they work before continuing with the rest of the program
- It is more likely to crash the computer as it is running directly on the CPU

- A cross compiled program can run slower on target machine than if it had been produced on the native machine, cross compilation also produces more errors and mistakes than a native compiler.

Interpreters

- It translates high level language program one statement at a time into an intermediate form
- Then executes that line/statement before moving on to the next one
- It reports on errors as lines of source code are processed and stops as soon as it encounters one
- The error has to be corrected before it can continue working on the next instruction
- An interpreter has to be resident in memory in order for the program to run
- Only a few lines of the program needs to be in memory at any one time saving memory space
- An interpreted program can be transferred between computers with different operating system because it remains in the form of source code but needs to be translated in each computer it is moved to

Advantages:

- Interpreters are able to execute each statement as it is entered and are able to generate helpful error reports which is useful during program development
- Debugging is easier with interpreters as error messages are output as soon as an error in a statement is encountered which gives the opportunity to correct the error there and then
- Interpreted programs are in original source so they can run on any system with the appropriate interpreter
- Interpreter makes use of less memory space when interpreting as only a few statements of the program needs to be in the memory, this allows small pieces of code to be tested before continuing with the rest of the program
- It can run partially complete programs when developing

Disadvantages:

- Execution process is slower for interpreted program as each statement must be translated before execution
- The source code must be available at all time with interpreted programs which can lead to software copyright infringement or intellectual property rights being at risk
- No executable file is produced
- Interpreter needs to be present during time of execution

Linkers

- A linker or link editor is a system program that combines object files or modules that have been created using a compiler into one single executable file
- It also replaces symbolic addresses with real addresses
- Most program are written in modular forms to help simplify the development process or due, a linker helps in joining these modules back into a single program file
- A larger program may be compiled in small parts due to insufficient space in RAM to hold the whole program and the compiler program
- The parts/modules of the programs can be storage on backing storage one at a time and each brought into RAM and compiled
- The resulting object code is then saved to the backing storage
- When all parts have been compiled, the pieces of object code can be brought into the RAM and the linker can be used to combine them into the complete program.

Advantages:

- Programs written in modules requires less RAM hence it saves money by not having to buy extra storage
- Whole program and compiler don't need to be in memory at the same time which requires less RAM and again saves cost of memory
- A number of programmers can be used to write separate modules which can save time compared to one person an writing the whole code
- If there is an error in the code only that module has to be corrected which prevents recompilation of other modules

Disadvantages:

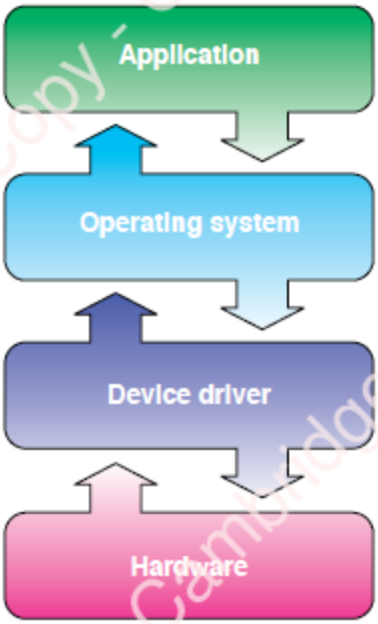
- There could be problems with different variable names being used for the same variable in different modules
- Documentation also has to be more detailed and takes longer to write or read when completed

Device Drivers

- A device driver is a small program that enables the operating system and application software to communicate with a hardware device acting as interface
- It controls the device connected to the computer
- Printer driver, mouse driver and keyboard driver are all examples of it
- Upon installation it detects and identifies the peripheral device
- It wakes up the device when it is needed and puts it back to sleep when it is not needed
- It handles the translation of the request between a device and the computer
- It defines where outgoing data must be stored before it can be sent

Example of it using printer driver:

- A printer driver acts as interface between the operating system and the printer
- When a document is to be printed, the application tells the printer driver and the printer driver tells the printer
- The user appears o have control of the device in the entire process
- Without the required printer driver the printer fails to work as the software used by the computer tends to be created by different companies to those that manufacture printers
- The printer driver is needed to convert the instruction set so the software is able to communicate with the hardware



Operating Systems and Utilities

- An OS is a software that manages computer hardware and software resources as well as interacting with device drivers
- It acts as interface between the user and the computer as well as supplying the important utilities for managing the computer
- It is stored on the hard disk but the instructions for loading the operating system are stored in ROM and are executed every time the computer is switched on
- The OS also acts as an interface between an application program and the computer hardware so that an application program can communicate with the hardware
- It also manages the shutting down of the computer by safely closing all running software on the computer bit by bit before sending a signal to power management hardware to turn off the power
- A multi user OS is when the system has more than one processor
- A multi-tasking OS allows more than one program to run at the same time and it allocates sufficient processor time to each program

Tasks performed by OS:

- Manages and allocates memory to software to make sure instructions and data from one program don't spread to another and hence cause the computer to crash or corrupt data
- Sends data/instructions to printers
- Responds to input devices and manages output data, it does this so by communicating with device drivers
- Opens and closes files on storage devices
- In multi-tasking/multiprogramming systems allocates equitable processing time to each task/program
- Sends error messages to applications/user when user intervention is required *such as when a wrong character like ' / ' is used for naming a file*
- Handles user logins*, password stored on computer are encrypted. When a password is used for login, a calculation is performed by the OS on stored encrypted password data and they are compared in order to allow user to access the system*
- Handles file permissions
- Provides the interface between the user and the computer

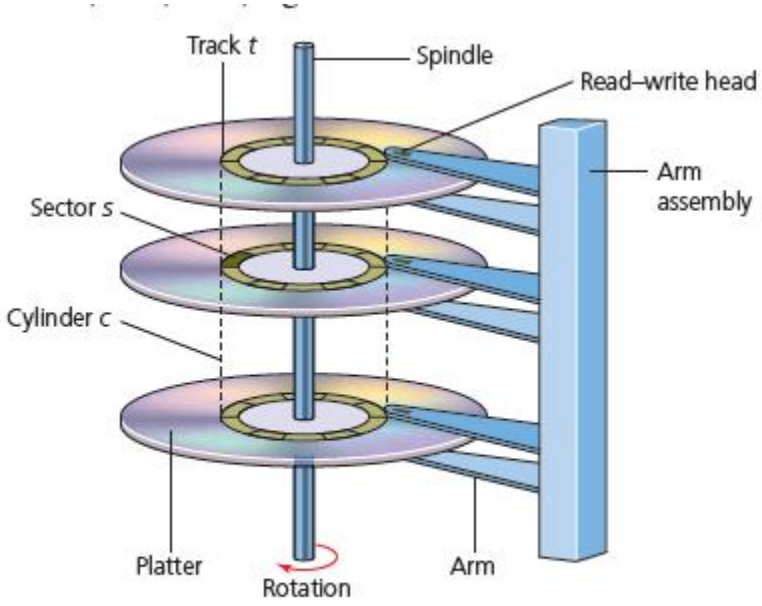
Explain how high level language is translated to run on different systems, including any difficulties which may result from this. [4]

- An interpreted program will still be in its original source code so it will work on any system but it must have an appropriate interpreter
- Only make use of high level languages which can be interpreted
- With languages which are compiled can use a cross compiler so programs can run on a computer with a different operating system
- Cross compiler can be small version of the compiler which is normally used on the host computer/native computer
- A problem with using a cross compiler is that the compiled program will no longer run on the computer the program was written on/host computer
- The cross compiled code can run more slowly than if it had been originally compiled on the target machine
- A cross computer produces more errors and mistakes than a native compiler

2.3 Utility software

- A utility program is a type of system software that assists users in controlling or maintaining the operation of a computer, its devices or its software
- Without utility software, the computer wouldn't function properly as it is required to manage the allocation of computer memory in order to improve the computers performance so that users can customize the appearance of their desktop
- Operating systems can contain a number of different utilities for managing files and storage devices
- It is needed to keep computer free from viruses and to make the file contiguous

The Structure of Hard Disk Storage:



▲ Figure 2.3 The structure of hard-disk storage

- A hard-disk drive consists of several platters which are individual disks
- Each surface of a platter has its own read-write head
- The read-write heads move across the platters/surfaces stopping only to read data or write data to the surface, they never touch the disk surface each of which is used to store data
- The platters are stacked one above the other and spin at the same speed
- Each surface is divided into several tracks which are in the same position on each disk
- The track on the top platter together with the tracks exactly below it, form a cylinder
- Each track is divided into sectors
- Data is written to the platters starting with the outside track.

- When a cylinder is filled with data, the read-write heads move towards the center of the disk.

Describe the terms:

- **sector:** It is the smallest storage unit on a hard disk, typically 512 bits
- **block:** Logical data unit composed of multiple sectors
- **track:** Concentric circles on a disks surface, organizing sectors
- **cylinder:** Set of corresponding tracks across all disk platters, enhancing data access efficiency

Disadvantages:

- Signature based method is only capable of dealing with known threats, a new unknown virus can do untold damage to the software or data stored on a hard disk because it is not known within the database
- False positives can occur in heuristic based detection, this is when the detection algorithm is so general that matches can be made with files that don't contain viruses but just happen to contain a small part of the sequence of bytes which make up the virus
- Behavioral based malware detection can also generate false positives

Disk Defragmentation

- Data stored on a disk may consist of several blocks which might not be next to each other as they would contain empty sectors between them, this means that the data file is fragmented around the disk
- Data deleted from the disk also leaves empty sectors between series of stored data/file
- Defragmentation software is used to organize the data on the disk by moving the data blocks around to bring all the parts of a file together so they are contiguous
- As a result data retrieval is made easier and quicker
- It attempts to create larger regions of free spacee
- With fragmented files it takes longer for the read-write heads to move over the surfaces to find all the different fragments of files than if data is held in sequence
- Software provides additional areas of free space and more storage capacity.

- It can also attempt to keep smaller files which belong in same folder/directory together by reorganizing other files

Formatting

- Disk formatting is the configuring of a data storage medium such as hard disk or SSD for initial use
- There are two levels of formatting; low level formatting and high level formatting
- The first stage is low level formatting which divides the disk surface into tracks, sectors and cylinders.
- This is done by magnetizing the disk areas using the write heads.
- Track are numbered starting from 0
- When the head goes from one track to the next, it leaves a gap
- Each track is organized into numbered sectors, starting at 1 and separated by gapes
- The purpose of low level formatting is to prepare the disk surface to receive data/allow user to save data
- High level formatting generates a new file system on the disk which allows the operating system to use the disk space to store and access files
- It does not permanently erase data but deletes pointers on the disk that tell the OS where to find them

Advantages

- Disk formatting can remove viruses
- In high level formatting, the files are retrievable

Disadvantages:

- if individuals rather than manufacturer are to carry out low level formatting then it can become almost impossible to restore data after erasing all the file and if done repeatedly it would shorten the life of the medium
- in low level formatting, the file aren't retrievable

Anti-Virus

- Anti-virus software can be a program or set of programs whose function is to detect and remove viruses
- It monitors a computer in a bid to prevent attacks from many types of malwares such as viruses, worms, Trojan horses, adware, etc
- It is important to keep anti-virus software up to date because new viruses and other malware appear at frequent intervals and old versions of anti-virus will not detect them
- Anti-virus software will either remove the virus and malware or quarantine, asking he user if they want to delete file or 'clean' it
- It can also does background scans of files, attachments and folders as well as the whole disk or computer, and inform user if anything is found
- These can take place automatically or scheduled to take place at set time
- There are different methods employed by an anti-virus to detect viruses
- **Signature based detection** is a method used by anti-virus which is based on recognizing existing viruses. When a virus is identified, anti-virus manufactures add its signature to a database of known viruses. It compares the contents of a file with its database of known malware signature.
- The **heuristic based detection** method detects malware based on characteristics typically known in malware code
- **Behavioral based malware detection** looks for abnormal or suspicious behavior such as sending a large number of emails. It can generate false positives. It is only able to detect malware after they have starting doing their malicious behavior
- **Sandbox detection** is based on behavioral based detection but doesn't detect the behavioral fingerprint run time. It executes the programs in a virtual environment within the computer whereby the suspected virus infected code is executed in the sandbox so that it can do no real harm.

Backup

- Backup software is a program that is used to keep copies of files from a computer or copy the content of a servers backing storage
- The backup is an exact duplicate of the files
- It can be used for restoring original file in case of accidental or deliberate corruption or deletion
- Backup software allows the user to select the type of backup, its time and frequency and where they want it to take place
- Additionally the user can also set up automated backups and retrievals of data.

- Backups can be stored on same drive or store on an external storage device; they can also be stored on a cloud.
- Most backup software also allow different types of backup such as incremental backup where only data that has been added or changed since a specific date is backed up
- A differential backup only backs up the data which has changed since the last full backup. Restoring the system requires the use of two backups in this case
- Users can also opt to verify their backup to make sure data matches and choose to encrypt the back or not.

Data Compression

- Data compression is the modifying of data so that it occupies less storage space on a disk, it can be lossy or lossless
- A lot of data in computer files is redundant with the same information listed over and over again, file compression programs remove this redundancy
- Lossless compression is where after compression the file can be converted back to its original state without loss of quality
- In it the repeated sequence of bits are replaced with a single character, then the repeated count along with the original character is stored making the original file size smaller
- When decompressed the codes are replaced with the original text. This type of compression is common with spreadsheets, word processed files and databases where loss of quality is of importance
- In lossy compression repeated bits are permanently deleted, but only those data bits which would have little effect.
- Jpeg is an image file format that supports lossy image compression. GIF and PNG use lossless compression

Advantages:

- Data can be transmitted more quickly over a network or the internet
- It saves storage space on a disk or SSD, reducing cost and time spent on storage
- It allows the streaming of high definition videos which would ordinarily occupy a great deal of bandwidth and memory

Disadvantages:

- Data compression software uses a lot of computer memory during the compression process
- The process of loading ac compressed file takes a lot longer than opening the original file
- Lossy compression cause a slight lowering of the quality of the resulting sound an video files

File-copying

- File copying is creating a duplicate copy of an existing file.
- The copy will have exactly the same content as the original
- In disk operating systems, they tend to involve the use of command line interface (CLI) where the user types some form of 'copy' command which contains the name of the original file as well as the destination directory or folder
- With a graphical user interface (GUI), the user can have both folder windows present on the screen and using the mouse, they can right click over the original file and select copy option from the drop down menu, right click over the destination folder, then select the Paste option from the drop down menu.
- There are now two versions of the same file in different folders.

Deleting

- The delete utility is a piece of software which deletes the pointers that tell OS where to find the file
- It removes the file name and address from a table which stores data about the file
- The space on the disk where the file was located is now available for future use by other files
- Moving a file to trash/recycle bin simple alters the directory path to indicate that the file has been temporarily deleted
- It is only deleted in as much as the software shows it in the recycle bin rather than in a normal folder
- Only when the file is deleted from the recycle bin is the file removed from the table and the files disk space is marked as available for reuse
- Until the operating system writes new data over these the file is still available

- A file recovery program can scan a hard drive for deleted files and restore them
- If the file has been partially overwritten, the file recovery program can only recovery part of the file
- It works by reinstating pointer in the File Addressing Table (FAT) as long as it is done before any data is over written

2.4 Custom-written software and off-the-shelf software

Custom-Written Software

- This is the software that is specifically written for a specific task and is developed for a specific company or business
- It is made from scratch and owned by the business
- The company might employ someone write a software that solves specific problems or meets their preferences
- The development costs in it have to be paid for by the client/company commissioning it
- Support is obtained directly from creators

Advantages:

- It is designed specifically for the task
- There will be no unnecessary features
- It doesn't have to be adapted for use
- Programmers are available to make any required modifications to the software
- Programmers will ensure that it is compatible with the existing system and software
- Custom written software will not have unnecessary features/bloat ware
- The company will own the copyright of the custom written software so can sell it to others
- The usually takes up less storage space than off the shelf software so there are less expensive data storage costs

Disadvantages:

- It costs more to pay programmers to write code specifically or the tasks/users needs

- Testing is limited to what the programmers think may be required based on how they think the software will be used
- Support is limited to the team of developers only
- It can take a long time to develop the software
- There may be a lot of bugs as it has not been tested thoroughly/ has not been used before

Off-the-Shelf Software

- This is software which already exists and is available straight away to organizations o, business and general public, ready for use
- It is owned by the company that created, customers purchasing don't have the rights to sell it
- It has to be adapted to fit the business needs and preferences and even with modifications, the purchasing company can't sell it to others
- This mean it can occupy large amount of storage space with unnecessary features
- The development costs for it are spread amongst several customers so it is relatively cheaper to custom written software
- Support can be obtained from help desks with experienced operators and there are likely to be user forums available by producers for the software

Advantages:

- Software is cheaper to buy as it is mass produced
- It will be available straight away
- Testing has been rigorously carried out by developers so there are unlikely to be any bugs
- There will be many sources of support including helplines with operators who will already have had to deal with a wide range of problems

Disadvantages:

- It has to be adapted to meet customers required needs and preferences
- It may have unnecessary features that would make use of large amount of storage space
- It may not be compatible with all the system of the customer

- Customers can't sell the software after purchasing they will only own a license

Proprietary Software (chp 10.5)

- Proprietary software is software that is owned by an individual or a company (usually the one that developed it)
- Users have to purchase a license to use it
- It has been created by a software company using a particular encoding scheme
- It is designed so that the decoding of this stored data is only done easily with software that the company itself has developed
- There are almost always restrictions on its use
- A software vendor delineates the specific terms of use in an end-user license agreement
- Its source code is almost always kept confidentially
- Usually covered by copyright which provides a legal basis for its owner to establish exclusive rights

Open Source Software (chp 10.5)

- It is free and openly available
- It is not covered by any copyrights/patents
- Allows users to modify and share it as those who create open source products publish the code
- It is easier to transfer data from one area to another as the computers being used ay not have compatible software
- It is able to read archive proprietary files whereas new proprietary software may not be able to read files that have been archived

2.5 User interface 49 1

- A user interface is the means by which the computer system interacts with the user
- It enables the user with the help of input devices to communicate with the computer and then via the OS, communicate with a piece of software or any output device

Command Line Interface

- The CLI is a means of interacting with a computer using commands in the form of successive lines of text
- A prompt appears in screen after which the command is typed in
- The output form the computer could be to produce a list or take some other action
- This interface is mostly used by software developers, system administrators and more advanced users
- It requires few resources than GUI
- It requires a keyboard and a screen
- It is possible to use CLI in a GUI

Advantages:

- CLIs processing speeds tend to be faster than the others
- CLI uses less memory than the others
- CLI is less likely to change over time whereas GUIs tend to change regularly meaning less need to learn how to use a new system
- Background noises and movements can interfere with dialogue interface and gesture based interface but it's not an issue with CLI

Disadvantages:

- Users with physical handicaps may not be able to use a keyboard or mouse
- For reasons of hygiene a doctor or restaurant chef may not e allowed to touch a display or device such as keyboard or mouse so gesture based or dialogue interface are more suitable in this instance
- CLI requires user to have to learn many commands unlike the other
- CLI commands are more difficult to edit
- CLI is more difficult to view different items on one screen when multitasking

Graphical User Interface (GUI)

- GUI uses windows, icons, menus and pointers collectively known as 'WIMP' interface to carry out commands such as opening, deleting and moving files.
- A 'WIMP 'interface is a subset of GUI and requires input devices such as a keyboard and mouse where as other types of GUI use different input devices such as a touchscreen
- A user can double click on an icon which could represent a file, a folder or application and open it.
- A right click on a two button mouse opens a menu
- By moving the mouse, the pointer can be moved up and down through the menu and then an option can be selected by clicking on it

Advantages:

- GUIs tend to be more accurate than dialogue and gesture based interfaces
- Background noises and movements can interfere with dialogue interface and gesture based interface but it's not an issue with GUI
- GUIs tend to be more user friendly
- Incorrect commands entered into GUIs are far more easier to correct than in other interfaces

Disadvantages:

- Users with physical handicaps may not be able to use a keyboard or mouse
- For reasons of hygiene a doctor or restaurant chef may not be allowed to touch a display or device such as keyboard or mouse so gesture based or dialogue interface are more suitable in this instance
- GUIs tend to change regularly which could be problematic for certain social groups like older people to learn how to use a new system
- Greater storage space is required in GUI

Dialogue Interface

- A dialogue interface allows a user to communicate with a computer or device using their voice.
- The computer uses speech recognition software to convert the spoken words into commands it can understand

- It requires a microphone to capture users speech, the user can load and run software packages and files by speaking into the microphone and saying the commands
- It requires the device to learn the way the speakers talks by asking the user to repeat certain sentences until it has learnt the way they talk
- The computer matches speech of user with the data it has stored in a database, the speech is converted into commands and action required takes place
- The computer can also responds back with spoken words after the text has been converted into speech
- Noise in the background while user is speaking and the ability to recognize only a limited vocabulary can cause problems
- Many cars have such system to allow the driver to control their phone or features in car like radio without touching them

Advantages:

- For hygienic reasons, a doctor/restaurant chef may not be allowed to touch a display or device, speaking into a microphone is a more hygienic way to control the device
- Dialogue interface allows hands free control which is beneficial in scenarios like driving a car as no hand has to leave the steering wheel
- Dialogue interface doesn't require the user to be sat in front of the computer/device, they can operate the device/computer remotely while doing other tasks at the same time
- Users with physical disability may not be able to use a keyboard or mouse or control their limbs accurately , for this instance dialogue interface would be the best type for them to use

Disadvantages:

- If there is background noise or user has a cold/strong dialect/accent/ it would affect a dialogue interface
- People who have speech impediment may find dialogue interface too difficult to use
- Dialogue interface can be expensive to develop in comparison with GUI and CLI
- Dialogue interface often requires training session with the user

Gesture Based Interface

- A gesture based interface is designed to interpret human gesture and converts these into commands
- Gestures can be made with any part of the body but it is usually the face or hand that makes the gestures the computer an interpret such as hand waiving, head nodding, finder pointing, eyes rolling/blinking
- A camera in conjunction with an infrared sensor detects the movements being made in front of it
- The computer using a special type of software, searches through all the gestures it has stored in a database to match it with the input
- Each stored gesture is linked to a specific command which is then executed after the gesture has been matched.

Advantages:

- Gestures may be a quicker way of initiating a response from device in comparison with other user interfaces
- People who have speech impediment can find gesture based interface useful rather than dialogue
- Gestures will still be reliable if there is background noise or user has a cold/strong dialect/accent/ which would affect a dialogue interface
- Dialogue interface often requires a training session with user whereas gestures can be taught through manuals
- Users with physical handicaps may find it easier to make gestures rather than gripping a mouse
- Users don't have to learn so many commands as with a CLI
- For reasons of hygiene doctors/health workers/ restaurant chefs may not be allowed to touch a display or device using a GUI, appropriate gestures are more hygienic way to control the device

Disadvantages:

- Users with physical disabilities may not be able to make gestures and might find dialogue interface much easier
- Certain gestures may not be socially acceptable and may be judged as inappropriate

- Certain gestures could be misunderstood by the computer particularly if the user has made it without realizing
- Gesture based is less effective when several users or background activity is involved
- Gesture based interface requires line of sight which isn’t necessary dialogue interface